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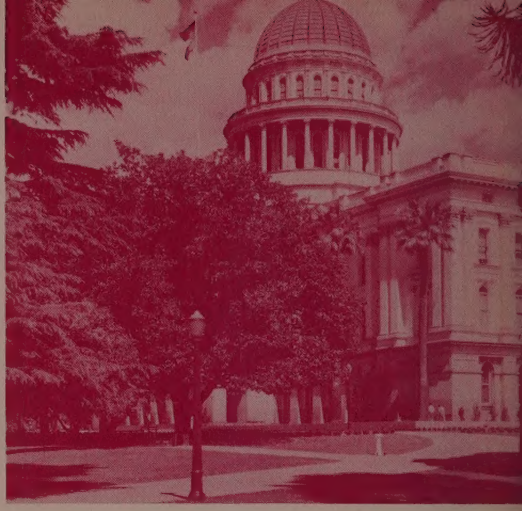

Table of Contents

OUR COVER: Representative illustration of the multitude of meat labels found in California retail grocery stores. The Bureau of Meat Inspection, California Department of Agriculture, passes judgment on approximately 3,500 different meat labels each year. See page 1 for meat labeling article.

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The Consumer's Interest in the Labeling of Meat Products

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The labeling of State inspected and passed meat and meat food products is required by the California Agricultural Code. The mark of state inspection reading "Cal. Inspected and Passed by Department of Agriculture" on meat and meat food products, or on the labels thereof, assures the consumer that the product has been inspected and found to be free of disease, clean, wholesome, free from adulteration, and truthfully labeled.

Labeling of meat and meat food products is an important part of the consumer's interest in the meat and meat products he eats.

He expects his meat to be prepared from animals that are healthy at time of slaughter, and under conditions that assure elimination of diseased carcasses and meat.

He expects his meat and meat products to be kept clean, handled under clean conditions, and kept free of adulteration during all phases of its preparation and handling.

He also expects meat products to be truthfully labeled or identified, according to generally accepted standards.

Authority for State Meat Inspection is contained in Division 3, Chapter 1, Article 1 of the Agricultural Code of California to assure the consumer of the protection to which he is entitled, with its over-all objective of a clean, wholesome disease-free meat supply which is not adulterated or mislabeled.

Purpose of Label Control

The California Meat Inspection Regulations require that marking devices and labeling material be reviewed and approved before their use and that they be used only under the direct supervision of an inspector from the Bureau. In a broad sense, the purpose of label control is to ensure that a true and clear picture of the product is available to the consumer. Specifically, the purpose is to require informative labeling, prohibit the use of false or misleading labeling, to prevent adulteration of product, and to prevent unfair trade practices. This requires that standards of composition or identity be developed for each product before the label can be approved.

Standards of Composition. It is not easy to discover what consumers expect of a meat food product, but "consumer expectancy" must be considered in order to promulgate a standard of composition. In identifying consumer expectancy for a food product, all sources of information must be consulted and evaluated. These include historical background of preparation and merchandising of the food, review of recipes in nationally known cookbooks, hotels and restaurants, and surveys to obtain consumer expectation. Standards of composition usually identify the minimum amount and kind of the more expensive meat and meat byproduct ingredients that must be used, and limit the maximum amount of the cheaper ingredients or nonmeat ingredients.

The U. S. Department of Agriculture's Meat Inspection Division recently reported that one of their establishment operators protested a regulation on a particular product which he desired to name as "sausage."

Although the proposed product contained well over the maximum fat permitted, the operator stated that the consumers in his particular area preferred their sausage with the higher fat content.

When informed that he would be permitted to manufacture the particular product provided it was properly labeled "Pork Fat, Lean Meat Added," the matter was dropped.

Preparation of Labeling Material

Labels, within the meaning of the meat inspection regulations, include any printing, lithographing, embossing or other markings on labels, stickers, seals, wrappers, or receptacles, and must contain certain required features. The required features of a trade label include (1) the true name of the product; (2) the word "ingredients" followed by

a list of ingredients when the product is fabricated from two or more ingredients; (3) the name and place of business of the manufacturer, packer or person for whom the product is prepared; (4) an accurate statement of the quantity of the contents; and (5) the inspection legend in the form shown and prescribed by the regulations. In addition, any product packaged in consumer sized impervious film containers which are usually displayed in self-service refrigerated counters shall have a statement such as "Keep Refrigerated" prominently displayed on the principal display panel of the label. A typical label is shown in figure 1.

It is required that the essential features of a trade label be prominently and informatively displayed on each principal display panel of the label. The display panel (or panels) is defined as that portion of the label which features the name of the product, and is displayed when the product is offered for sale.

Name of Product. The name used to designate the product must be the common or usual one, should reflect the method of preparation of the product, and clearly describe the finished product. It must be prepared in conformance with its respective standard of composition and with all other applicable regulations. Statements used to qualify the name of a product, such as "Cereal Added," or "Nonfat Dry Milk Added," are considered to be a part of the name, and must be prominently and informatively displayed contiguous to the name of the product.

Statement of Ingredients. The statement of ingredients includes the word "Ingredients" followed by a colon and a list of the ingredients arranged in the descending order of amounts used. These ingredients should be listed by common or usual names.

The term "spice" may be used to identify one or more natural spices, in lieu of naming the specific spice or spices.

"Flavoring" may be used to identify spices, essential oils, oleoresins and other spice extractives, onion powder, onion juice, or garlic juice.

Name of Manufacturer. The name of the manufacturer or packer, may, with few exceptions, appear without qualification on labeling material. Certain names, however, may be misleading unless qualified by words such as "made by." If the name appearing on a label is not that of the manufacturer or person preparing the product, the name will be qualified by a phrase such as "Prepared for _____" which reveals the connection of the person named to the product.

Statement of Quantity. The statement of quantity must be an accurate statement of the contents and must be given in avoirdupois weight, if the product is a solid, and in terms of liquid measure, if the product is liquid.

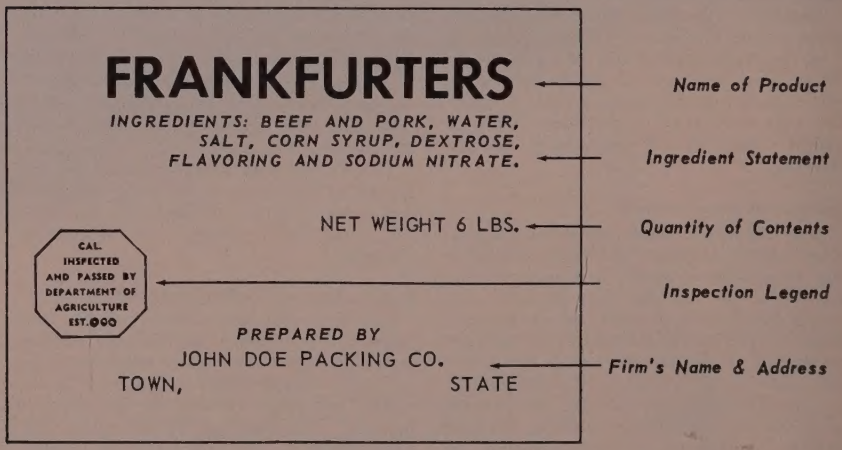


FIG. 1. Typical label showing the five labeling features.

Inspection Legend. The inspection legend must appear on that portion of the label featuring the name of the product, or in case of two or more panels, on the principal display panel. This legend is illustrated in figure 2. **No deviation from the form shown is permitted.**

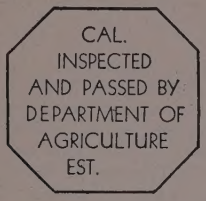


FIG. 2. Inspection legend. Each establishment is assigned its own establishment number.

Misleading Features. Misleading features are not permitted on labels. No word, statement, picture, design, or device that conveys any false impression, or gives any false indication of origin or quality, should appear on a label. Words, pictures, or designs, which have reference to a geographical location other than that in which the product is prepared, must be qualified by an appropriate statement indicating the locality in which the product is prepared.

Illustrations that are not representative of the contents of the container are required to be qualified by a prominent statement, such as "Serve As Illustrated."

Submission and Approval of Labeling Material. For the convenience of the establishment in eliminating expenses, trouble, and loss of time, sketches or proofs of proposed labeling may be submitted to the Chief of the Bureau of Meat Inspection, California Department of Agriculture, for review before going ahead with the preparation of the finished material. Sketches must be prepared in duplicate and when received in Sacramento, minor adjustments may be made which will permit tentative acceptance of the label.

Finished labeling material for use on meat products must be submitted in quadruplicate through the local inspector. Four copies are required so that, after action, a copy is returned to the inspector, a copy is sent to the establishment operator, a copy is forwarded to the supervising inspector, and the final copy is retained at the Sacramento office.

Detailed information submitted with labeling material concerning the composition and method of preparation of product is, of course, held confidential.

Of the 3,789 labels and sketches for sausage and other meat products submitted to the Sacramento office for approval in 1960, 3,670 were officially approved and 119 failed to meet requirements. Many other labels not included in these figures were returned without action for revisions or other reasons.

Use of Labels

The use of labels is restricted to those products for which they have been approved. They cannot be applied to any product which has a container or covering bearing any statement that is false or misleading, or is so made, formed, or filled as to be deceptive or misleading.

The label must be so placed on a container that all the features of the label are shown on the principal display panel. In the case of transparent covering, the required features should be of a color which offers sufficient contrast with the color of the product so that such features will be prominently displayed. The ink used must be of a permanent type, and the label printed in such a manner that all required features are clearly legible.

Labeling material, including the printing thereon, should be constructed of harmless substances so that the product will not become contaminated.

The labeling of all containers of inspected and passed product must be under the supervision of a Bureau inspector, and containers must be filled with product which is strictly in accordance with the statements on the label.

Sausage is the only mystery item the meat packer has to sell—Solve the Mystery—Read the Label.

The Kennebec Potato— A Favorite for Processing

By MILO R. LADWIG *
Bureau of Market News, California Department of Agriculture

Any study of potato production and marketing must consider the increasing shift to processing outlets as compared to fresh consumption outlets.

The Kennebec potato is prominent in the changing picture of the potato industry in California. In 1949 only 5% of U.S. potato production was processed. By 1960 this percentage had increased to approximately 25% of total U.S. production.

Significantly, the increase in processing utilization has served to check a decreasing national potato consumption trend. This had dropped from 128 pounds per capita in 1940 to 100 pounds in 1951, but had risen to 107-110 pounds per capita by 1960. The increase in consumption followed the increase in processing, and emphasizes on the processing factor in potato marketing. Reliable authorities in the potato industry now predict that processing use will exceed fresh potato use within ten years. This situation could change the growing, harvesting, and marketing of the entire potato crop.

The principal processed potato forms are numerous but may be broadly classified as chips, frozen products, dehydrated, prepeeled, canned, and starch.

The newer frozen and dehydrated items have caught on with other convenience foods, resulting in a spectacular jump in consumption during the past several years. The old favorite, potato chips, has also shared in the increase, now accounting for 50% of all potatoes sold to processors.

In the past few years new processing plants, producing a variety of potato products, have entered the field. Large established food distributing organizations have added a variety of the newer potato products to the list of food items which they produce or distribute. Widespread advertising and selling programs have sharply increased sales.

* Mr. Ladwig is a Senior Marketing Specialist (Fruit and Vegetable), Federal-State Market News Service, Bakersfield, California.

Plants Are Widely Scattered

Processing plants are located in all sections of the U.S. About half of the total processed potato products in the country are now produced by plants located in Idaho. California plants are almost exclusively engaged in potato chip production.

California potato production is mostly "new crop," moving immediately into consumer channels. Kern County is the principal producing section of new crop potatoes in California. Kern County production has long been established as a major factor in the nation's potato picture during May and June each year. Over half of the total U.S. potato supplies for this period originate in Kern County. The 10-year average planting of this early crop is 49,680 acres. This crop has been generally of the White Rose or Long White variety. Round Reds usually make up about 10% of the total acreage. Recently, Kennebecs have replaced some of the Long White acreage and in 1960 accounted for 15% of the total plantings.

The processors' interest in early California potatoes has brought about the increase in Kennebec plantings.

The Kennebec variety is popular because of its superiority for the manufacture of chips and other potato products.

Kennebec acreage in Kern County has more than doubled from the 1957 to the 1960 season. Data on acreage, yield, and production are not segregated by variety in official California Crop and Livestock Reporting Service estimates. However, statistics assembled from various local government or other local sources indicate that the 1960 Kennebec acreage totaled 5,800 out of a total planting of 51,000 for all varieties combined.

Big Increase In Production

Production from the 1960 Kennebec acreage amounted to nearly 1,700,000 hundredweight, which was 40% above the previous season.

Statewide, the 1960 Kennebec acreage amounted to 12,600 out of a total of 101,800 acres of all varieties combined for the entire crop year.

Kern County had about half of the total Kennebec acreage planted in California in 1960. Most of the remaining Kennebec acreage was grown as a fall crop in Monterey County and the balance was scattered throughout other potato growing districts in the state.

Monterey County had 4,150 acres of Kennebecs in 1960, practically the entire potato planting in that county.

A further increase in California Kennebec acreage is anticipated.

California ranked third among the states in 1960 in Kennebec production. About half of the Kennebec production in California was marketed within the state and the balance was marketed elsewhere.

Kennebec Developed in Maine

The first commercial planting in California was made in 1950. A small acreage was planted in Kern County in the spring of 1952. The variety was originally developed by U.S.D.A. potato specialists at the Presque Isle, Maine, station. It was released for planting in 1948 and is now widely grown in most U.S. potato producing areas, except in the southeastern U.S.

The Kennebec has the desirable attributes of smooth appearance, shallow eyes, early maturity, and high yields. It has proven superiority for processing purposes, particularly for potato chips. It doubles as a table variety and often substitutes for the popular Long White when the latter is in short supply.

Potato chip firms and other processors turn to new crop each spring as old stock loses desirability for this utilization after lengthy storage.

The eastern and midwestern sections of the United States produce more Kennebecs than is produced in the western United States, but these crops are for late summer and fall harvest.

Harvesting California potatoes. The active harvest season includes almost every day in the year. Winter potatoes (November 5-March 31); Late spring (April 10-July 15); Early summer (July 1-August 10); Late summer (July 20-October 15); Fall (September 1-November 30).

The recent increase in Kennebec production in California has tended to hold up total potato production in the state. This is especially true in Kern County where acreage previously planted to Long Whites has been shifted to Kennebecs to satisfy the demand for early processing potatoes.

Contracting Practices

As consumer acceptance of processed potato products has continued to rise, processors have sought assured sources of supply at stable prices. This has resulted in a well established practice of contracting with growers at planting time for predetermined needs. Most Kennebecs are marketed in California on a contract basis. This differs from other commercial potato production where growers usually wait until harvest time to market their crops.

Contracts for sale of Kennebecs are usually executed between growers and brokers at or prior to planting time. These brokers in turn contract with various processors. This intermediary broker or agent facilitates the handling of many details which would be cumbersome or difficult in direct contracting between processors and growers.

The broker can adjust harvesting or delivery dates to meet changing conditions. He can arrange for various outlets, including deliveries to small processors who would find it difficult to contract directly with growers. In fact, the broker plans the field operations, arranges and adjusts delivery schedules, and coordinates harvesting, transporting, and delivery of potatoes from acreage under his control.

This acreage may be grown by several or more growers. A brokerage fee or commission is charged the processor for these services. Some larger agents act entirely as contract buyers at planting time and in turn during the growing and harvesting period arrange for resale of their holdings. Some contracts may be negotiated by larger processors directly with growers.

Bulk handling of potatoes. The freshly harvested crop is transported by truck from the field and dumped into a concrete receiving vat filled with water.

Contracts generally establish price, time of delivery, quantity, size, grade, and certain lesser details.

For very early season delivery in April in Kern County contract prices are set at a higher level than for later season delivery as yields are usually lower.

Prices Set on Sliding Scale

A sliding scale by weeks reduces prices for delivery as the season advances.

Contract prices in 1960 for field run Kennebecs ranged from $2.00-3.00 per hundredweight, net to the grower, according to date of delivery.

Most volume moved in the range of $2.25-2.50 during the period of heaviest harvesting from May 15 to June 30. The grade was generally required to be 85% or 90% U.S. No. 1 quality or better, balance U.S. No. 2.

The minimum size specified in most contracts is 1⅞ or 2 inches in diameter.

Early in the season processors accepted some smaller sizes when overall supplies were short.

Good field run lots of Kennebecs require little culling to meet processing contract grade requirements. However, most lots are run over a grading table so that obvious culls may be removed. Some contracts allow acceptance in the grower's field, at time of harvest, without grading. Most processing plants are able to grade and prepare for use lots which do not meet U.S. Grade requirements. Quality of potatoes intended for processing is important but much less culling and grading is necessary at shipping point than is required for table stock potatoes.

Generally, appearance factors, shape, smoothness, and color are not as important to the processor as to the buyer of table stock. Potato chippers prefer good quality compared to other processors because of the saving in preparation for use.

Some Kennebec acreage in California is grown without a contract agreement. In Kern County this acreage is estimated at 10-20% of annual production of this variety. This production is marketed at harvest time to processors or buyers of table stock potatoes and may net growers higher returns

than contracted crops if overall supplies are short. Likewise, growers having contracts, but who produce in excess of contract limits due to good yields, may market the excess in the same manner.

Transportation to processing plants in palletized bins is becoming common where hauls are comparatively short. These bins also permit economical handling for storing or conditioning of the potatoes, if necessary.

Some Varieties Are Unsuitable

Most potato varieties may be utilized for processing. However, suitability varies widely among varieties according to specific gravity, soils, cultural practices, length of time in storage, and many other factors. In fact, some varieties are suitable for dehydrated products or frozen French fries and not too suitable for chips. Long Whites are in the latter category as they tend to produce dark colored chips.

Basically, overall desirability for processing is determined by specific gravity and the property of producing light colored chips or other processed forms.

Darker colored chips or off colored potato flakes which turn out grayish mashed potatoes meet consumer resistance.

Kennebecs rank high in specific gravity, thus having a higher percentage of solids content or dry matter compared to Long Whites and certain other varieties. Higher solids content means a higher processed yield from a given weight of raw potatoes. All potato varieties must be mature to attain maximum solids content. The ratio of yield of processed products from raw potatoes is extremely important to processors where all costs are closely watched.

In a recent study, tests of all varieties grown in Kern County showed that this ratio varied from 5.6 to 9.2 pounds of raw potatoes per pound of flakes. For all lots

Processed potato products, in many forms, are available in most California grocery stores. A broad classification includes chips, frozen products, dehydrated, pre-peeled, canned and starch.

of Kern County potatoes tested, the average was 7.8 pounds of raw potatoes per pound of flakes.

Processors rate Kennebecs as outstanding for chipping because of high yield and light colored chips. As measured by specific gravity, Kennebecs generally compared favorably with the high quality Russet Burbank. Usually, field checks are made to determine specific gravity before digging, as variation exists from field to field. Comparatively simple field test equipment is used to test potato samples for this purpose.

Careful Handling Necessary

The Kennebec has a few undesirable characteristics. It does not store well in all producing areas. It is susceptible to certain viruses and soft rots and does not ship as well without breakdown as many other leading varieties. Careful handling of the Kennebec after harvesting is usually necessary. For distant shipments from California points during May and June refrigeration is necessary. This reduces suitability for processing as the potatoes must be conditioned or "warmed up" for a period before use.

Potato seed producers and United States Department of Agriculture specialists are continuously seeking improved potato varieties. One day the Kennebec may be replaced by a further improved variety. This appears unlikely at present as production is increasing and Kennebecs ranked third among all potato varieties in seed production in the U.S. in 1960. This increase attests its importance among the numerous varieties now grown commercially.

Today California has several very large potato chip plants in Los Angeles and Oakland. Smaller chip plants are located at various points throughout the state. California potato producers are hopeful that other forms of potato processing will be developed within the state. Year around availability of potatoes suitable for processing, quality of processed products to meet competition from other areas, labor availability, and water supply are factors which will determine California's future in this field.

Aerial Photography Used in Estimating California's Grape Crop

UNIQUE PROJECT FINANCED BY CALIFORNIA WINE ADVISORY BOARD

Aerial photography to estimate California's raisin crop was used for the first time during the 1960 season. This was probably the most unique project in crop estimating ever undertaken by the Bureau of Agricultural Statistics. The work was made possible by funds provided by the Wine Advisory Board which operates under the supervision of the Director of Agriculture.

The grape industry presented the Bureau, better known in agricultural circles as California's Crop and Livestock Reporting Service, with this interesting and complex problem. People in the grape industry wanted information on the rate at which raisins were being made and the probable total tonnage dried during the season at the earliest possible date. Methods traditionally used by the service, such as mailed inquiries and field enumeration, required too much time. The use of aerial photography was suggested, the subject was explored with a pioneer firm in the State, and a program was developed.

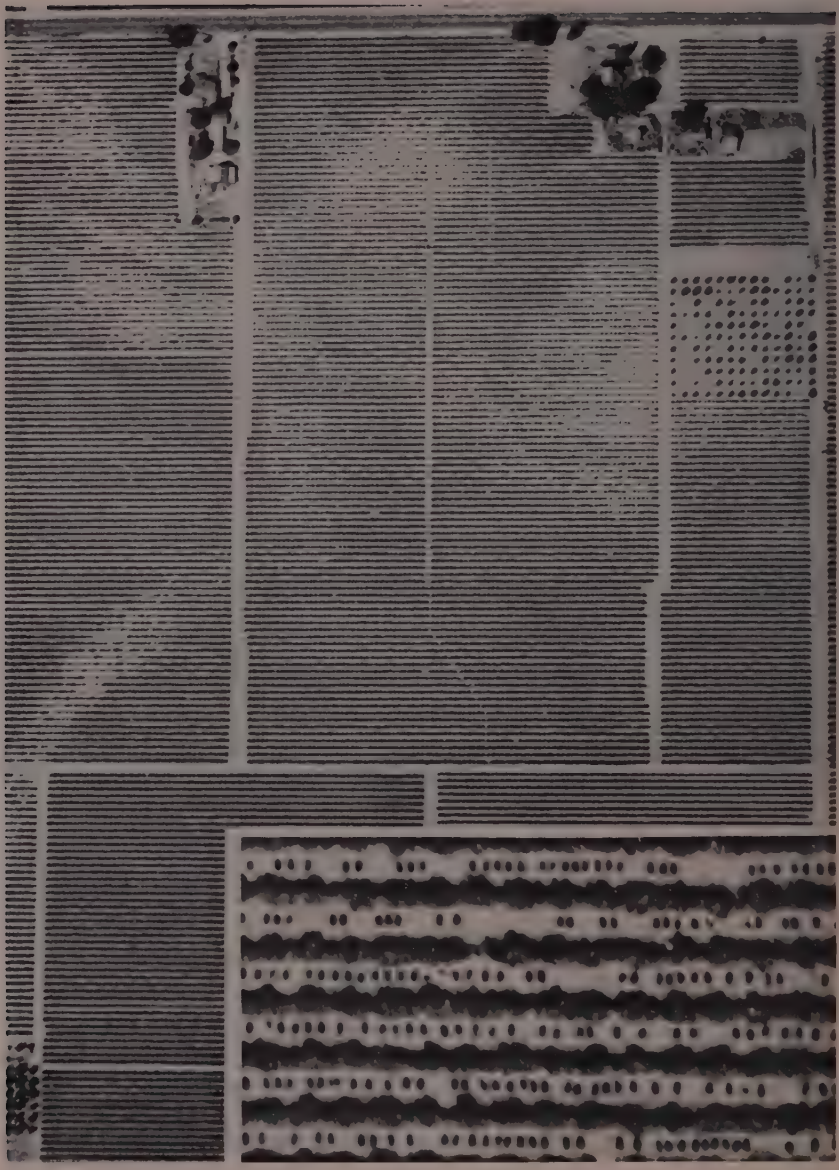
Estimates of raisin production are of critical importance to not only the raisin industry but to the State's huge wine industry as well. The Wine Industry's concern centers on the volume of raisin variety grapes made into raisins. That portion of the raisin grape crop left on the vines after the drying season is over is an important part of the supply of grapes for crushing. An optimum utilization between the grapes going for raisins and the grapes remaining for other uses is important to the entire California grape industry.

For a number of years the California Crop and Livestock Reporting Service has made estimates of raisin production based on field surveys shortly after the completion of tray laying. The five aerial surveys conducted this past season marked the first time that the acreage laid to raisins and the progress of tray laying could be observed during the lay season, and this progress reported to the industry in less than twenty-four hours after completion of each aerial survey.

The area covered by the aerial surveys covers approximately 825 square miles in the Fresno area extending north to Madera, west to Caruthers, south to the Kingsburg raisin district, and east past Sanger, Reedley, and Dinuba. It is estimated that about 95 percent of the acreage normally laid to raisins falls within this area.

During the 1960 season photographs were taken on August 26, and on the 2nd, 6th, 11th, and 19th of September. Estimates were made on acreage laid to raisins as of each date. Photography was done by Clyde Sunderland, aerial photographer, of Oakland, California. They used a K-17 aerial camera with 12 inch focal length, which takes a 9 inch square picture. The altitude flown was approximately 8,400 feet so that each picture incorporates a little more than one square mile of ground area. Each survey included approximately 270 exposures along prescribed east to west flight lines, covering about one-third the area for which estimates were made. The aerial photo crew left the Oakland airport each flight day at 8:30 in the morning, arriving over the raisin area at around 10:00 a.m. About half the photography was done during the morning,

Photographer and pilot check over flight map before take-off on aerial photograph raisin estimating project. Sunderland aerial photographs, Oakland.



In the inset photograph, with 20 times magnification, older raisins with very high contrast can be easily detected at the one mile scale. Photo was taken with the P-2 camera at the one-half mile scale. The large photograph was taken at three-quarter mile scale.

(1) C. M. Long, Agricultural Statistician, counting raisin trays from photographic image projected on viewing screen; (2) Henrietta Zambon, Supervising Clerk, demonstrates use of transparent random point overlay for sampling; (3) Mrs. Zambon codes photographs for acreage laid to raisins.

Interior of Cessna airplane model 195 showing camera installation. Sunderland aerial photographs, Oakland.

then the crew landed for lunch, delivered this exposed film to another pilot who started his delivery to Oakland immediately, thus permitting earliest possible availability of the photos. The camera crew completed the photography in early afternoon and made their return to Oakland by 4:00 p.m., with the balance of the film. Since the raisins are laid on approximately 2 x 2½ foot trays on the ground and are bordered on either side by a row of vines it was necessary that the photographing be done during the middle of the day to avoid shadows from vines.

Analysis of the film was done by a group of specially trained statisticians and clerks from the California Crop and Livestock Reporting Service. These people arrived in Oakland at 4:00 p.m. on the day of each flight, shortly before development of the morning photos was completed. Since it was necessary to complete analysis, summarize data, and prepare an estimate for release by around 9:30 the following morning, the entire job was done at the photographer's lab in Oakland. Tabulating equipment such as comptometers and automatic calculators were transported to Oakland from Sacramento for each survey.

The negatives were sampled for raisin acreage on a film editing table which provided illumination from behind the film. The use of the negatives rather than prints was necessary in order to maintain as much sharpness of image as possible. Points on the photos were selected for sampling by placing a transparent plastic overlay with random points marked on it over the photos. Each point was then checked by hand lens to determine if the point covered was in grapes and if raisins were laid. Ratios were obtained from this procedure which, applied to known or estimated land and grape acreages within the sampled area, yielded estimates of raisin acreage laid at the time the photographs were made.

To estimate raisin trays laid per acre, the photos were projected at a magnification of about four diameters. Random points were again sampled, on the projected image, to locate plots for counting trays. The sample plots chosen represented about 1/10 of an acre, all trays within them were counted, and the counts expanded to an acre basis according to the scale of the picture being projected. The sampling and summary work preparatory to making the estimates of acreage and trays laid started around 4:30 p.m. and continued until about 5:30 a.m. Analysis of the data and preparation of the estimates was completed in most instances by 9:30 the following morning, less than 24 hours after the aerial photography was completed.

Some problems are connected with the present sampling procedure. Photographs taken past the peak raisin laying period do not include trays laid earlier which have been rolled or removed from the vineyard. This necessitates careful comparison of such photographs with those taken earlier. Another problem is the ground resolution or visibility of small objects such as raisin trays in photographs with a scale of one inch to over 600 feet.

As a result of the first year's experience, several refinements in procedure are planned for 1961. These will include better photographic scale, improved devices for photo analysis, and improved sampling procedures based on additional data gained from the 1960 surveys.

Pear-Juniper Rust, a Disease New to California and the United States

By ARTHUR H. McCAIN, Extension Plant Pathologist, University of California, Berkeley, Calif., and

DAN Y. ROSENBERG, Plant Pathologist, California Department of Agriculture, Sacramento, Calif.

Pear-juniper rust caused by *Gymnosporangium fuscum* DC. (=*G. sabinae* (Dicks.) Wint.) was diagnosed for the first time in California in September of 1960 (20).

This disease of pear and juniper is endemic and generally distributed in Europe (10), causing considerable damage to pears grown in close proximity to certain *Juniperus* species (9, 11).

The rust is also present in North Africa, the Near East (10) and Canada (28). Saccardo (23) records the rust in North America, and Seymour (25) lists it as occurring on *Pyrus communis* L. Neither Arthur (5) nor Kern (17) record the rust as occurring in North America. The rust was intercepted by the U.S.D.A. Plant Quarantine Branch on *J. chinensis* var. *pfitzeriana* arriving by air from Germany or Netherlands in 1952 or 1953 (16).

The growth and fruit set of heavily infected pear trees is reduced (14) and infected leaves tend to abscis early in the season. Pear fruits also may be attacked (12).

Occurrence in California

In September, 1960, *Gymnosporangium fuscum* was recognized infecting pear trees on one property in the Lafayette area of Contra Costa County. To determine the extent and degree of infestation, inspections of all pear trees in the area were made by personnel from the Contra Costa County Agricultural Commissioner's office and the California Department of Agriculture. The area involved is mainly residential with a number of small pear plantings and is located in a small valley with large hills to the north, south and west. The wind generally moves from the west. From the original infestation, infected pear trees were found about 1 mile to the West, ¼ mile to the Southwest, and 1 to 1½ miles to the North and Northeast. The area of infestation covers approximately 4 square miles.

In February, 1961, the fungus was recognized in this same area on several juniper plants, *Juniperus chinensis* var. *pfitzeriana* and *J. sabina* var. *tamariscifolia*, in a mixed planting in which a seedling pear tree, heavily infected with the fungus in the fall, was growing.

Symptoms and Signs

On pear one or more circular or irregularly shaped yellow-orange spots up to 2 cm in diameter occur on upper and lower surfaces of the leaves (Figs. 1 and 2). On the upper surface in the centers of these spots, grouped in an area of 5 to 7.5 mm, are the pycnia which appear as small black dots. The aecia are found on the lower surface opposite the pycnia perched on orange-brown cushions of hypertrophied tissue, 2 to 3 mm thick (Fig. 2). Each aecium is surrounded by an off-white, acorn-shaped peridium 2 to 5 mm high (Fig. 2). The peridium develops many longitudinal splits from the apex to the base, allowing the aeciospores to escape, but remains closed at the apex and is persistent (Figs. 1 and 2). The aeciospores are globoid, chestnut-brown, 22-28 x 25-30 μ; the wall is 3-4 μ thick and finely verrucose (6). Infections of leaf petioles and twigs are occasionally found. Fruit infections have not been observed in California.

On juniper the telial stage occurs on branches and twigs causing very slight or no enlargement to fusiform swellings (Fig. 3) several inches long (6, 17). The infections in juniper are perennial and often kill the infected branch or twig in three to four years. In the spring in France, beginning in March, the telial horns break through the surface of infected branches. They were first seen in California in late February. When they first emerge or during dry weather, these horns are small, firm, dark

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brown bodies a few millimeters across (Fig. 3). In a moist atmosphere, especially during rainy periods, they swell and become gelatinous, 8-10 mm long, cylindrical or conical, laterally compressed, and reddish-brown in color. The telial horns are composed of teliospores and their stalks. Two types of teliospores are formed: thick-walled (2.5 μ) teliospores, chestnut-brown in color and 42-47 x 23-30 μ in size, occur towards the outer surface of the gelatinous telial horns; thin-walled (17 μ) teliospores, colorless, and 44-51 x 18-24 μ in size occur deeper in the telial horn. The stalks of the teliospores are very long, 84 x 6.3-7.3 μ. The teliospores can germinate at once producing sporidia (basidiospores) measuring 18-20 x 15 μ. Only the sporidia are capable of infecting pear (6, 17).

Host Range

The telial hosts include the following: *Juniperus chinensis* L., *J. c.* var. *pfitzeriana* Spaeth., *J. communis* L., *J. excelsa* Bieb., *J. foetidissima* Willd., *J. japonica* Carr., *J. nana* Willd. [*J. communis* var. *nana* Loud.], *J. oxycedrus* L., *J. phoenicea* L., *J. pyramidalis*? [*J. virginiana* var. *pyramidalis* Carr.], *J. sabina* L., *J. s.* var. *tamariscifolia* Ait., *J. s. variegata*, *J. sphaerica* Lindl., *J. sibirica* Burgsd. [*J. communis* var. *saxatilis* Pall.], *J. tripartita* (Hort.) [*J. virginiana* var. *tripartita* Senecl.], *J. virginiana* L., (6, 9, 17, 24, 28).

Aecial hosts include: *Pyrus amygdaliformis* Vill., *P. betulaefolia* Bge., *P. cummunis* L., *P. elaeagrifolia* Pall., *P. lindley* Rehd., *P. michauxii* Bosc. (*P. amygdaliformis* x *P. nivalis*), *P. nivalis* Jacq., *P. orientalis* Pall., *P. salicifolia* Pall., *P. syriaca* Boiss., *P. tomentosa*, *P. ussuriensis* Maxim., and *Pyronia danieli* (Winkl.) Rehd. (= *Cydonia oblonigia* Mill. x *Pyrus communis* L. graft chimera) (6, 19, 28).

Disease Cycle

Extrusion of telial horns begins during March and continues into May in France. In California, the telial infections become active in late February. The teliospores may germinate at once producing basidiospores capable of infecting pears. The optimum temperature for teliospore germination is 64°F., while some germination occurs at 46° and 73°F. The optimum temperature for basidiospore germination is also 64°F., but the upper and lower limits are 53° and 68°F. (6).

The first visual evidence of infection of pear, the appearance of the pycnia on the upper leaf surface, occurs 7 to 20 days following inoculation (7). Bernaux (6) studied the development of the aecial stage in France. In 1946 the earliest pycnia were observed May 16 with the greatest number evident June 11. The first evidence of hypertrophy of pear leaves was observed June 5. The first peridia were observed September 17 and the first aeciospores were emitted September 21 and continued to be produced until October 25. Bernaux found that *G. fuscum* has the most prolonged life cycle of any of the *Gymnosporangium* species studied; teliospore formation occurs later in the spring and the development of the aecial stage is also very long.

The aeciospores are carried by air currents to junipers. Juniper infections occurring in the fall presumably do not produce teliospores until the spring of the second year, 15 months later. However, in California, telia were observed on juniper leaves that appeared to be less than 6 months old.

It has been suggested that the rust may overwinter in pear trees as mycelium in the buds (12, 21), although Deckenbach (11) conducted tests which indicated that reinfection occurs each spring from spores produced on junipers.

Control

Urediospores—sometimes called repeating spores since they reinfect the host on which they are produced—are not produced by *G. fuscum*. Since the aeciospores produced on pears will infect only junipers, and the sporidia of the teliospores that are produced on junipers will infect only pear, elimination of either host will control the rust. In some regions of Europe, extermination of infected junipers in the vicinity of pears is compulsory (3, 4, 14), but in certain localities wild junipers are so numerous that they cannot be removed (6, 11).

The disease is of economic importance on pear only when a large proportion of the leaves are affected (14). Damage is severe when infected junipers are within 33 yards of pears and diminishes until at 220 to 330 yards the risk becomes negligible (14). An epiphytotic of *G. fuscum* on pears in Switzerland was associated with the proximity of *J. sabina* (2). On pear trees contiguous to infected junipers 950 out of 1,000 leaves were infected. For distances of 55, 220, and 1,090 yards the number of infected leaves

FIGURE 1. Heavy infection of pear foliage by the aecial stage of the pear-juniper rust fungus, *Gymnosporangium fuscum*.

FIGURE 2. Symptoms and signs of pear-juniper rust on pear leaves. Yellowish-orange spots with many minute black specks (pycnia) in their centers occur on the upper leaf surfaces and red cushions with off-white projections (aecia) occur on the lower surfaces.

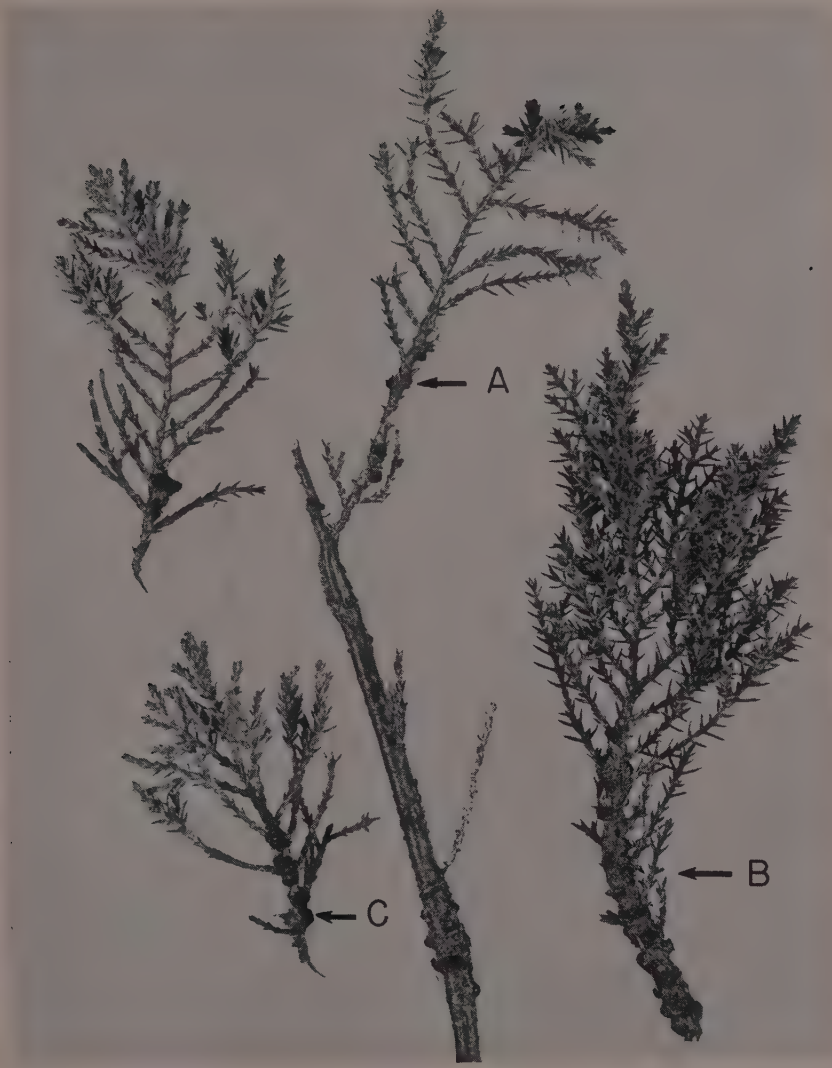

FIG. 3. Telial stage of *Gymnosporangium fuscum* on juniper twigs. Note that the size and shape of the swellings vary from very slight to enlargements on the twigs (a) to fusiform swellings about six centimeters long on the branch (b). The small, firm, dark-brown bodies (c) a few millimeters across that occur on the swellings are the telial horns (see text).

per 1,000 was 100, 20-30, and 2 respectively. However, infections on pear leaves have been found up to 3.8 miles from any junipers (8), an important consideration in the potential spread of the rust from an initial locus.

Success with chemical controls has been variable (9, 11, 14, 18). Bordeaux spray applied to pear trees during one month following the pre-bloom stage has given some degree of protection (9). Lime sulfur 1:40 gave very good results when repeated after every rain for about one month (11). Sprays applied to junipers apparently have not been tried for this rust.

The use of bordeaux and ferbam for the protection of red cedar, *J. virginiana* L., from infection by *G. juniperi-virginianae* is sometimes practiced (1, 22). Protective sprays of ferbam at the pink, petal-fall and 10-day stages of apple development gave satisfactory control of the rust diseases in New York (22). Strong and Klomparens (26) found that one application of cycloheximide at 100 ppm prevented germination of teliospores of *G. juniperi-virginianae* and *G. globosum* when applied to *J. virginiana* L. in the spring. No foliage injury was observed. Cycloheximide also arrested the development of *G. juniperi-virginianae* in apple leaves, when applied at 1 ppm as soon as the infections were visible, but caused undesirable spotting of the fruit and foliage (27).

Eradicative procedures are being carried on by the Agricultural Commissioner of Contra Costa County in cooperation with the Bureau of Plant Pathology. Since the infested area is primarily residential and has large plantings of ornamental junipers, eliminating *Juniperus* sp. would be difficult to accomplish. There are approximately 5,000 pear trees in the infected area and these also would be impractical to eliminate. Therefore a spray program was undertaken in order to prevent infection of the junipers. All were sprayed 5 times with a ziram preparation (4 lbs of 76% ziram/100 gallons of water). The sprays were applied at 10-day intervals. Other measures will be taken that are deemed necessary to effect eradication of the fungus from the area.

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New Weed Problems

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The formation of new weed problems occurs by changing the hereditary composition of the plant population, by moving a species into a new geographical area where the ecological conditions are different from its native range and by disrupting ecological conditions, particularly by humans, creating favorable environment for a species to become a weed. In any case, if such change is great enough, it is possible for a species to become sufficiently abundant to then be classified as a weed, a plant not desired in that particular situation.

The hereditary shift of characteristics in a population is extremely difficult to demonstrate. Two cases have appeared recently that show some approach in that direction, although in neither case is a new weed problem developed.

Xanthium campestre is a name that is applied to the large fruited Cocklebur that originated in Butte County, California. All forms of cockleburs are more properly classified as minor variations of *Xanthium strumarium*, which has spread into eastern and western North America from Mexico. The flowers of these plants have only one sex in a flower head, and the heads are arranged on the stem so that the female flowers are below large numbers of male flowers. As these female flowers are in a continual shower of pollen from the male flowers of the same plant, every generation of these annual plants results in inbreeding. Variations in the fruit or bur are then easily passed on from one generation to the next. *Xanthium campestre* remained endemic to a very small area in Butte County until 1955, when this form spread with the flood waters down the Sacramento River. In the mingling of this large fruited form with our common form *Xanthium italicum*, an apparent hybrid (Fig. 1) has been formed with fruits that appear intermediate to the parental types. From the standpoint of the vegetative plant, all forms of Xanthium are quite identical,

FIG. 1. Fruits of Cockleburs. Left—*Xanthium campestre;* center—hybrid of *Xanthium campestre* and *X. italicum;* right—*Xanthium italicum.*

resulting from this intense inbreeding. Therefore, no new control problem is presented by this formation of a new kind of fruit, but this case does give some indication of the genetic drift that may occur in populations by combinations of characters already present in the populations.

In the summer of 1960 a population of apparent hybrids between *Sorghum halepense*, Johnson Grass, and *Sorghum virgatum*, Tunis Grass, was found at the edge of a grapefruit orchard north of Indio, Riverside County. Both parent species are present in the area as weeds. These hybrid plants show the vigorous extensive rhizomes of Johnson Grass, the very narrow seed heads of Tunis Grass. This population has been removed in the Johnson Grass control program in this area.

Alternanthera philoxeroides, Alligator Weed, (Fig. 2) is an aquatic species native to South America. It is known in California only as scattered infestations for 20 miles along the Rio Hondo and then along the Los Angeles River to near its mouth. In Louisiana there is estimated to be some two and a half million acres of rice land and waterways infested with Alligator Weed. Reproduction in this species in California appears only to be by vegetative means, by pieces of the floating stems being carried by the water and these pieces rooting in wet river banks. We have looked for seed in different times of the year for a number of years, and have yet to find any development of fruit or seed. Formation of seed is not proven in the Gulf States, but an occasional occurrence of small plants in the field has suggested that seed may rarely be formed. This lack of viable seed in California makes the problem of control much easier to solve, and also greatly reduces the chance spread of Alligator Weed to other waterways and to our rice growing areas.

Cirsium ochrocentrum, Beaumont Thistle, (Fig. 3) is a perennial species with a creeping rootstock, native from Arizona to Texas and Nebraska. This species was first observed as a weed in 1952 near Beaumont, Riverside County. Because of its obvious perennial nature and capabilities of becoming a serious weed of rangelands, control measures were started immediately by the Agricultural Commissioner of Riverside County. It was not until 1960 that Dr. Gerald B. Ownbey concluded that this material is properly identified as *Cirsium ochrocentrum*. The identification in this particular group of Cirsium is difficult because of the variability encountered in each species. *C. ochrocentrum* has been listed as native to Inyo County, California, based on specimens of *C. nidulum*. This material from Beaumont has been listed as *C. undulatum*, another similar variable species, but typically having a tuberous swelling of the tap root. Besides the Riverside County infestation, *C. ochrocentrum* has occurred in California as a weed in three small localities in Lassen County, in San Diego County, and near Walnut in Los Angeles County. The largest single infestation of about four acres is found south of Vinton, Plumas County, where solid patches of this thistle occur among the sagebrush to the exclusion of forage species of plants.

FIG. 2. Alligator Weed, *Alternanthera philoxeroides*. a. flower cluster; b. plants rooted in the bank and growing into the water.

Linaria dalmatica, Dalmatian Toadflax, (Fig. 4) is an escaped ornamental species, native to the eastern Mediterranean Region. The plants are perennial from a shallow thick woody rootstock that sends up numerous creeping shoots. Because of the creeping rootstock, it is a plant species that is commonly passed from one garden to another as there is always enough to give away. Also, a single plant produces an enormous quantity of minute seeds. Under experimental conditions plants were not established in uncultivated plots where the normal forage cover was undisturbed. In the cultivated plots, therefore disturbed areas where the cover was removed, seedlings became established readily. This species has been reported as infesting over 100,000 acres of land in eastern Washington. In California, Dalmatian Toadflax is quite restricted as yet in the size of the infestations. The largest area is about 30 acres in northern Modoc County. There are a number of small infestations in central Siskiyou County. The plants are unpalatable to livestock and therefore it is a serious range pest.

FIG. 3. Beaumont Thistle, *Cirsium achrocentrum*. a. immature and mature flower heads; b. plants in clumps from perennial rootstocks.

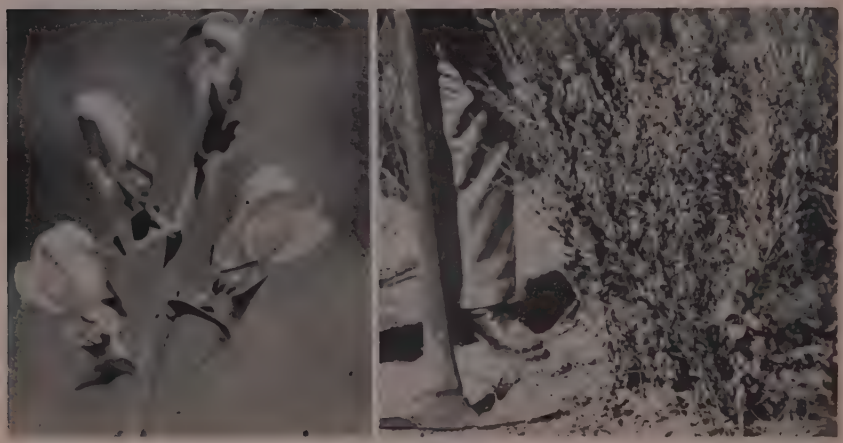

FIG. 4. Dalmation Toadflax, *Linaria dalmatica*. a. flowers showing long spurs; b. plants.

FIG. 5. Austrian Peaweed, *Sphaerophysa salsula*. a. flowers and leaves; b. light seeds—alfalfa, dark seeds—Austrian Peaweed.

FIG. 6. Musk Thistle, *Carduus nutans*. a. flower head; b. two-year-old plant.

Sphaerophysa salsula, Austrian Peaweed, (Fig. 5) is a noxious weed in some states because the seed is mechanically inseparable from alfalfa seed when the latter is harvested. The plant is quite similar to some of our native Locoweeds in the genus Astragalus. The proper taxonomic position of this species has not been determined; as to whether it belongs to the small Asiatic genus *Sphaerophysa* or to the larger Australian genus *Swainsona*. The plant is recognized as *Swainsona salsula* in the administration of the Federal Seed Act. This species is native from the Caspian Sea to China. Its arrival in the United States as a weed has been traced to plantings of Turkestan alfalfa seed. The only infestation currently known in California is a scattered population of over two acres, northwest of Old River, Kern County. This same field is infested with Russian Knapweed, *Centaurea repens*, and formerly was infested with Camelthorn, *Alhagi camelorum* both species also traceable to Turkestan alfalfa seed. A single collection of Austrian Peaweed was made in 1939 in a roadside ditch in Bakersfield, but there has been no further record of this species there. The Austrian Peaweed is perennial from a thickened woody taproot; the plants grow to 3 feet or more tall with small brick-red, pea-like flowers with a yellowish center. The pod is inflated and similar to that produced in Astragalus.

Carduus nutans, Musk Thistle, (Fig. 6) is a biennial species native to the Old World that now occurs as a weed at scattered localities throughout the western states. This species is a serious weed from the standpoint of its extremely rapid spread by seed. The only current infestation in California comprises about one acre in an irrigated pasture in Apple Valley south of Victorville. This population is under an eradication program by the Agricultural Commissioner of San Bernardino County. Another infestation of this species occurred in 1954 near Walnut, Los Angeles County. Spring applications of 2,4-D have been effective in the control of Musk Thistle. Also close mowing two times a year to prevent seed formation and clean cultivation have been effective in other western states.

Onopordum acanthium, Scotch thistle, (Fig. 7) is a biennial species native of Eurasia. The plant is covered with a matted layer of long white hairs and therefore is sometimes called Cotton Thistle or Silver Thistle. A flowering plant may grow to 9

FIG. 7. Scotch Thistle, *Onopordum acanthium*. a. two-year-old plant; b. flower head.

feet with branches spreading to 4 or 5 feet. A population may become sufficiently abundant to exclude cattle from a particular area. This species is of limited distribution in California, currently present in Modoc, Lassen, Lake and Trinity Counties. The largest infestations are in southwestern Modoc County and adjacent Lassen County. Control with 2,4-D ester in oil has been good when applied before the flowering stalks are shooting up. Cultivation has been quite effective in reducing or eliminating stands.

Onopordum tauricum, Taurian Thistle, (Fig. 8) is a biennial species similar to *O. acanthium*, except that the flowering plants are covered with long glandular hairs. It is native from northeastern Asia Minor to Aragon, Spain. This species is limited to a single 4-acre infestation southwest of Dorris, Siskiyou County. The only other infestations in the United States are in Pueblo County, Colorado, where the species is listed as an escape from cultivation. Although found in 1959, this California infestation is known locally to have been the same size in 1942. The population is showing some signs of moving in scattered plants being found along roadsides away from the main infestation. This species is under an eradication program by the Agricultural Commissioner of Siskiyou County.

Andropogon virginicus, Broomsedge, is an unpalatable perennial bunchgrass, native to the Gulf States and Mexico. Most of the earliest collections of this species as a weed in California are from the County Agricultural Commissioners and the State Department of Agriculture in the years 1928 to 1931 from Shasta, Butte and Yuba Counties. The species has gradually spread along the western slope of the Sierra Nevada Mountains to Fresno County where it was first collected in 1958. The plants commonly are found along waterways and in places of poor drainage, but also may be found over exposed slopes as the dominant plants. The future of this species as a weed is still not fully determined in relation to overgrazing, etc., but certainly any small new infestations should be eradicated.

Stipa brachychaeta (Fig. 9) is a perennial bunchgrass native to Argentina, Uruguay and Chile. Both weedy occurrences in California of this coarse unpalatable grass have been found in alfalfa. In 1949 this species was collected at the southern edge of Fresno. The second collection was made in 1960 near Camarillo, Ventura County. The tight clumps of the grass mechanically interfere with the cutting of the alfalfa by rapidly dulling the cutting blades and by bouncing the mowing bar up over the alfalfa plants.

FIG. 8a. Taurian Thistle, *Onopordum tauricum*.

Euphorbia oblongata (Fig. 10) was found in 1954 in Contra Costa and Solano Counties. Native to Greece and the eastern Mediterranean Region, this perennial species is adventive in Europe. These California infestations are the only ones known in North America. The perennial taproot forms as many as 20 upright stems to 3 feet tall, repeatedly branching above and producing large quantities of seed that are spread by the explosive force of the capsules. The present infestations in California total less than two acres in waste ground and city gardens.

Eupatorium adenophorum, White Thoroughwort, is a perennial herb growing to six feet or more in height, often in solid patches to the exclusion of all other vegetation. This species is native of tropical America and probably is an escape from cultivation in California. The first record as a naturalized plant is a collection made in 1896 in a canyon south of Pasadena. In the 1920's this species spread rapidly in Los Angeles County, persisting in canyons of low ele-

FIG. 8b. Taurian Thistle, *Onopordum tauricum*. Flower head showing glandular hairs on bracts.

FIG. 9. *Stipa brachychaeta*. The near side of the clumps is cut by the sickle bar; the far side of the clumps is not cut and bounces the bar in the air.

vation in places where there is year-round water supply. It is now found in scattered localities in coastal California from San Diego to the San Francisco Bay area. In coastal bluff locations these plants persist in quite dry soil where reached by the moist ocean air. Recently in Griffith Park, Los Angeles, the plants are persisting and spreading in areas where sprinkler irriga-

FIG. 10. *Euphorbia oblongata*. Clusters of flowers with warty seed capsules.

FIG. 11b. Common Sneezeweed, *Helenium autumnale*. Flower heads.

FIG. 11a. Common Sneezeweed, *Helenium autumnale*. Weedy infestation in an irrigated pasture.

tion is being used. This species of Eupatorium was considered one of the worst pasture weeds in Hawaii until relatively effective biological control was started in 1945. Before that time the planting of Kikuyu Grass was recommended as a control measure for this rather chemically resistant species. These scattered populations in California represent potentials for spread into irrigated areas, particularly where sprinklers are used, in addition to the eradication of the native flora which has already occurred by this species.

Helenium autumnale, Common Sneezeweed, is native to three counties across the northern end of California. Its natural occurrence is typically at the margins between the valley meadowlands and the swales that drain them. Irrigation of these meadowlands has therefore produced ideal conditions for this species (Fig. 11). The plants are unpalatable to livestock and therefore increase in numbers at the expense of the forage plants. The species spreads both by short creeping perennial rootstocks and by large quantities of wind-borne seed. In Scott Valley, Siskiyou County, this species is already sufficiently abundant to be a considerable weed problem. At flowering time in late summer and fall these plants are particularly toxic to sheep, rarely to cattle, causing the so-called "spewing-sickness" if the animals are forced to eat them. All parts of the plants are toxic and the poison is cumulative; complete recovery from such poisoning rarely occurs. Treatment with 2,4,5,-T has been used with some success in small areas.

Helenium amara, Bitter Sneezeweed, is an annual species often cultivated as an ornamental. It is a widespread weed of the southern states and recently is spreading northward. The common name is applied because of the bitter flavor produced in milk when cows eat these plants. Horses and mules are also poisoned by these plants. There are no infestations known in the State at this time. The infestation near Modesto was eradicated by the staff of the County Agricultural Commissioner in 1959.

The detection of new species of weeds is a continuing function of the personnel of the California Department of Agriculture and of the County Departments of Agriculture. New infestations of weeds are continually being found, both by routine surveys for such purpose and from the interest of property owners, commercial weed control personnel, and others. Emphasis is placed on this early detection of new weed species so that an evaluation of its economic importance can be made before the population has become too large for feasible control. After this detection of the population the proper action of containment, control or eradication can be made. The threat to the agriculture of the State is still from the *unknown* populations of serious weeds that may become established and increase in size.

1932—California Department of Agriculture Buried Seed Project—1960

By EMRO C. BRUCH, Field Supervisor of Seed Inspection
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In October, 1932, W. L. Goss of the California Department of Agriculture published in the Monthly Bulletin a plan of the buried weed seed experiment started at the U. S. Cotton Experiment Station at Shafter. This project was undertaken as a weed control measure to ascertain how long certain weed seeds would remain viable.

The seed, as reported by Mr. Goss, was placed in soil in unglazed pots inverted in saucers and the whole assembly was buried approximately one foot beneath the surface of the soil. The pots were buried in groups of a dozen sets, each separated sufficiently so that each set might be dug at a different interval of time. They were buried in two locations, one irrigated and the other non-irrigated. Seeds of Johnson Grass, Camelthorn, Hoary Cress, Wild Morning-glory, Russian Knapweed, Yellow Star-thistle, Russian Thistle, Silverleaf Nightshade (White Horsenettle), Klamath Weed, Creeping Mallow, Puncture Vine and Silversheath Knotweed were used.

Each pot contained 100 or 200 seeds, as indicated by the attached chart, except 25 capsules of Creeping Mallow and 25 burs of Puncture Vine were used, each having approximately 5 seeds per capsule or bur.

We failed to find the original germination percentage of these seeds recorded, but, as indicated by the chart, the germination one year after burial was of sufficient viability to be a hazard if planted with a field crop. The chart also indicates the germination of the different kinds of seed at the particular date of digging and testing. You will notice that the germination appeared to decline on most varieties within 3 or 4 years.

In subsequent testing of the seed, the practice had been to plant the soil and the seed together in a germinator and to count the resultant sprouts as the percentage of germination for the particular year. At the recent digging in 1958, it was decided that possibly a little closer scrutiny would be necessary and at that time the seed of each lot was separated from the soil and we made a startling discovery that the seed was not in evidence but it appeared that insects had invaded the project and that some of the seed had disappeared.

The notable exception was in the case of Morning-glory. At the end of 34 days in the germinator the irrigated and non-irrigated lots were found to germinate 22 and 30 percent, respectively. This test was continued, however, and all of the seeds remaining ungerminated at that time were clipped so that moisture would penetrate the seed coat and as a result we had a completed germination test of 93 percent or the irrigated portion and 67 percent of the non-irrigated portion. This test was based on 57 and 79 seeds, respectively. Other seeds had been destroyed by insects or other causes.

This report is chiefly negative in nature with the exception of the report on Wild Morning-glory seed. We have learned many things on the buried weed seed project, namely:

Photograph No. 1. Exposed pots containing weed seed planted by California Department of Agriculture in 1932. The pots are buried about one foot deep in a plot set aside by the U. S. Cotton Experiment Station, Shafter, California. A set of pots is dug every five years to check on the germination of the seeds.

CALIFORNIA DEPARTMENT OF AGRICULTURE
BURIED WEED SEED PROJECT, SHAFTER

Germination of Buried Weed Seed (1933-1958)

	Number of seeds	Germination by years expressed in percent							
		1933	1934	1936	1938	1943	1948	1953	1958
Johnson grass									
Irrigated	200	89.00	65.00	35.50	.50	0	0	0	[e]0
Unirrigated	200	78.60	[a]2.00	29.00	2.00	0	0	0	[e]0
Camelthorn									
Irrigated	100	5.00	[b]5.00	0	0	0	0	0	[e]0
Unirrigated	100	16.00	3.00	0	0	0	0	0	[e]0
Hoary Cress									
Irrigated	200	41.50	48.50	0	0	0	0	0	[e]0
Unirrigated	200	40.00	.50	0	0	0	0	0	[e]0
Morning Glory									
Irrigated	100	7.00	3.00	[c]60.00	[c]67.00	0	9.00	0	[c]53.00
Unirrigated	100	6.00	3.00	[c]82.00	[c]74.00	0	6.00	0	[c]53.00
Russian Knapweed									
Irrigated	200	74.00	68.00	1.00	0	0	0	0	[e]0
Unirrigated	200	74.50	46.00	1.50	0	0	0	0	[e]0
Yellow Star Thistle									
Irrigated	200	44.50	52.00	3.00	0	0	0	0	[e]0
Unirrigated	200	47.00	43.50	.50	0	0	0	0	[e]0
Russian Thistle									
Irrigated	200	92.00	8.50	0	0	0	0	0	[e]0
Unirrigated	200	80.00	1.50	0	0	0	0	0	[e]0
Silver Leaf Nightshade									
Irrigated	200	16.50	4.50	42.50	71.00	21.50	25.00	0	0
Unirrigated	200	18.00	10.50	71.50	2.50	60.50	17.00	1.50	0
Klamath Weed									
Irrigated	200	24.00	3.50	19.00	43.50	.50	0	0	0
Unirrigated	200	27.00	15.00	12.00	25.00	0	0	0	0
Creeping Mallow	capsules								
Irrigated	[d]25	16.80	.00	3.20	0	0	0	.80	[e]3.00
Unirrigated	[d]25	5.60	1.60	4.00	1.60	0	0	.80	[e]4.00
Puncture Vine	burrs								
Irrigated	[d]25	32.00	21.60	2.40	0	0	0	0	[e]0
Unirrigated	[d]25	35.20	17.60	3.20	0	0	0	0	[e]0
Silver Sheath Knotweed									
Irrigated	200	74.00	22.00	12.00	3.50	0	0	0	[e]0
Unirrigated	200	75.00	24.00	9.00	3.50	0	0	0	[e]0

[a] Live grub in pot when taken up.
[b] Live sprout in pot when taken up (included in the germination percentage).
[c] Hard seed clipped
[d] Approximately 5 seeds in each capsule or burr. Percentage of germination based on number of seedlings from estimated number of seeds.
[e] No seed found in pot; evidence of pods, husks, etc. found.

1. The invasion of insect life is a natural hazard to the longevity of the weed seeds.

2. Any future project of this nature should include protection of the seed from this natural enemy.

3. The soil types used in this test were not uniform in nature and might have contributed to a variable situation.

4. A control sample should be kept in an insect-proof room of normal temperature to check on any insect losses that might be experienced.

PRODUCTION AND VALUE OF PRINCIPAL PRODUCTS OF CALIFORNIA FARMS

1959 (Revised) and 1960 (Preliminary)

Commodity	Acreage		Unit	Production		Value[1]	
	1959	1960		1959	1960	1959	1960
Cattle and calves	---	---	lbs.	1,820,850,000	2,253,995,000	458,724,000	514,721,000
Dairy products	---	---	lbs.	7,695,000,000	7,880,000,000	375,279,000	382,711,000
Cotton lint	875,000	944,000	bales	1,929,000	1,950,000	310,230,000	311,056,000
Hay	1,966,000	2,086,000	tons	6,756,000	7,228,000	172,278,000	177,086,000
Eggs	---	---	no.	5,160,000,000	5,625,000,000	135,450,000	166,875,000
Grapes	409,101	416,180	tons	2,861,000	2,694,000	142,380,000	131,761,000
Oranges	145,020	136,460	bx. 77#	40,200,000	30,800,000	122,580,000	110,453,000
Tomatoes	169,100	172,800	tons	2,355,000	2,578,750	102,940,000	108,008,000
Potatoes	98,100	101,800	cwt.	27,725,000	28,672,000	78,377,000	79,988,000
Lettuce	119,100	125,100	cwt.	19,118,000	20,815,000	76,103,000	76,054,000
Turkeys	---	---	lbs.	246,982,000	278,739,000	61,499,000	71,078,000
Barley	1,757,000	1,722,000	bu.	68,523,000	68,880,000	70,579,000	70,258,000
Rice	285,000	288,000	cwt.	13,252,000	13,536,000	55,526,000	57,528,000
Prunes	81,752	80,122	tons	139,000	139,000	50,179,000	53,515,000
Sugar beets	208,300	208,000	tons	4,928,000	4,160,000	56,672,000	[2]
Peaches	83,478	87,343	tons	937,000	910,000	49,110,000	46,640,000
Chickens	---	---	lbs.	260,922,000	275,049,000	41,514,000	44,938,000
Cotton Seed	---	---	tons	759,000	777,000	33,700,000	40,404,000
Walnuts	121,796	123,525	tons	58,500	70,000	28,256,000	37,100,000
Strawberries	13,200	11,700	lbs.	170,280,000	156,780,000	32,504,000	31,536,000
Dry beans	267,000	239,000	cwt.	3,718,000	3,246,000	33,090,000	30,837,000
Pears	38,438	36,260	tons	405,000	363,000	27,135,000	30,460,000
Celery	17,600	18,300	cwt.	8,670,000	8,492,000	30,059,000	29,413,000
Cantaloups	48,900	53,300	cwt.	6,908,000	6,713,000	31,811,000	29,344,000
Lemons	50,355	50,703	bx. 79#	16,900,000	17,100,000	32,448,000	28,899,000
Sheep and lambs	---	---	lbs.	128,075,000	147,844,000	24,500,000	27,497,000
Almonds	89,155	89,118	tons	82,800	53,000	38,585,000	25,864,000
Asparagus	77,800	75,400	cwt.	1,867,000	1,960,000	21,005,000	23,081,000
Apricots	36,536	36,195	tons	210,000	230,000	23,730,000	22,950,000
Field corn	250,000	210,000	bu.	18,250,000	15,750,000	25,550,000	22,050,000
Carrots	24,600	23,800	cwt.	6,844,000	5,872,000	27,159,000	21,501,000
Grain sorghums	300,000	276,000	bu.	24,265,500	24,167,300	20,088,000	18,814,000
Alfalfa seed	153,000	141,000	lbs.	58,140,000	51,465,000	19,186,000	16,983,000
Hogs	---	---	lbs.	86,344,000	90,314,000	14,508,000	15,778,000
Apples	21,284	20,715	bu.	10,900,000	9,300,000	13,446,000	14,129,000
Wheat	371,000	352,000	bu.	8,718,000	7,744,000	15,605,000	13,939,000
Broccoli	26,300	27,200	cwt.	1,466,000	1,550,000	11,656,000	12,496,000
Plums	21,755	23,268	tons	93,000	82,000	10,440,000	12,240,000
Olives	28,171	28,277	tons	27,000	70,000	6,183,000	10,500,000
Onions	14,600	13,700	cwt.	5,063,000	4,560,000	10,679,000	8,927,000
Wool[3]	---	---	lbs.	19,014,000	19,803,000	8,176,000	8,713,000
Cherries	9,938	10,374	tons	15,000	24,000	6,915,000	8,601,000
Sweet potatoes	13,000	12,000	cwt.	1,014,000	900,000	7,108,000	8,370,000
Snap beans	8,300	7,800	tons	64,500	47,850	9,919,000	7,703,000
Avocados	20,205	20,045	tons	51,500	70,000	8,652,000	7,659,000
Cauliflower	14,700	15,800	cwt.	2,397,000	2,607,000	7,329,000	7,348,000
Sweet corn	21,200	19,800	cwt.	1,583,000	1,352,000	7,232,000	7,268,000
Green lima beans	22,100	28,000	tons	37,680	46,200	5,426,000	6,962,000
Watermelons	21,600	21,300	cwt.	3,372,000	3,580,000	9,543,000	6,560,000
Brussels sprouts	4,800	4,700	cwt.	624,000	658,000	5,175,000	5,854,000
Cabbage	10,500	11,600	cwt.	2,444,000	2,535,000	5,541,000	5,609,000
Honeydew melons	6,600	8,200	cwt.	1,087,000	1,140,000	5,802,000	5,297,000
Oats	197,000	197,000	bu.	6,895,000	6,501,000	5,447,000	5,201,000
Cucumbers	6,200	6,300	tons	62,072	60,852	4,991,000	5,154,000
Figs	21,138	20,574	tons	63,900	58,900	5,240,000	5,106,000
Green peppers	4,800	4,500	cwt.	864,000	698,000	7,332,000	4,704,000
Grapefruit	7,361	8,129	bx.	2,530,000	2,700,000	5,089,000	4,595,000
Nectarines	6,318	8,218	tons	39,000	44,000	4,485,000	4,464,000
Hops	5,800	5,100	lbs.	9,338,000	7,497,000	5,323,000	4,273,000
Artichokes	9,400	9,300	cwt.	376,000	418,000	3,419,000	3,712,000
Garlic	3,200	5,400	cwt.	272,000	459,000	2,576,000	3,534,000
Honey	---	---	lbs.	1,368,000	27,072,000	1,532,000	3,384,000
Flaxseed	45,000	29,000	bu.	1,710,000	957,000	4,959,000	2,967,000
Chili peppers	5,670	4,600	tons	8,480	5,980	4,062,000	2,870,000
Spinach	10,900	10,600	tons	76,300	73,800	2,923,000	2,841,000

PRODUCTION AND VALUE OF PRINCIPAL PRODUCTS OF CALIFORNIA FARMS—Continued

1959 (Revised) and 1960 (Preliminary)

Commodity	Acreage		Unit	Production		Value[1]	
	1959	1960		1959	1960	1959	1960
Dates	4,163	4,153	tons	26,000	22,700	3,328,000	2,701,000
Ladino clover seed	16,000	21,000	lbs.	4,160,000	4,200,000	2,288,000	2,520,000
Green peas	11,200	10,300	tons	19,790	19,960	2,402,000	2,126,000
Sudan grass seed	10,000	11,000	lbs.	15,800,000	17,600,000	885,000	1,091,000
Persian melons	1,400	1,600	cwt.	168,000	184,000	924,000	1,012,000
Red clover seed	4,700	4,000	lbs.	2,044,000	1,740,000	672,000	452,000
Purple vetch seed	45,000	26,000	lbs.	8,100,000	3,900,000	535,000	312,000
Pomegranates	590	655	tons	3,000	3,200	360,000	246,000
Beeswax	---	---	lbs.	287,000	569,000	126,000	245,000
Persimmons	528	526	tons	2,700	1,500	243,000	210,000
Rye	9,000	10,000	bu.	117,000	130,000	132,000	143,000
Merion blue grass seed	230	370	lbs.	98,000	141,000	122,000	141,000
Mustard seed	750	1,500	lbs.	750,000	1,822,000	71,200	136,600
Alsike clover seed	3,300	1,000	lbs.	1,023,000	500,000	191,000	85,000
Mohair	---	---	lbs.	28,000	33,000	18,000	25,000
Common vetch seed	1,000	1,000	lbs.	300,000	220,000	18,000	14,000

[1] For livestock, livestock products, poultry and poultry products data are cash receipts for the calendar year. Crop values relate to value of production and are on a crop year basis.
[2] Data for 1960 are not available at this time.
[3] Wool data for marketing season April-March.
NOTE: The above data do not provide a complete record of all agricultural products in California because official estimates of many minor crop and livestock enterprises are not available. These data should not be used to compute farm income since they include duplication between livestock items and the value of home-grown feeds used in their production.
SOURCE: Bureau of Agricultural Statistics (California Crop and Livestock Reporting Service).

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